

Fighting back: human adaptations in marginal environments

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Environment 41:6 6-11, 25-29 (July–August 1999)

http://www.findarticles.com/p/articles/mi_m1076/is_6_41/ai_55237737/pg_6

Studies of the fragility of the natural environment often accord a prime role to human activities such as habitat destruction, land cover change, and "overuse" of biotic resources. One of the factors most closely associated with environmental degradation in the developing world is poverty. A well-known analysis suggests that the poor are found disproportionately in the dryland, highland, and rainforest zones of the tropics, several of which have been identified by other researchers as "critical" in terms of the quality of their natural resource base and the stresses placed upon them by human uses.(1)

These perceptive analyses offer a picture of spiraling degradation, growing poverty, and the displacement of people to accommodate economic growth and population increase. This article, by contrast, examines cases that lead to a different conclusion. While aggregate or regional statistics present a depressing picture, it is quite evident that at the local level many land users and communities have been able to reduce their environmental impacts, sustain their livelihoods, and fight back against institutionalized poverty through a process of innovation, technological choice, and social organization.(2) Their experiences may offer important lessons for environmental management in general.

In designing policies to combat resource degradation and poverty, it is important to take a fresh look at these experiences and the ways in which (to use the language of development professionals) "sustainable livelihoods" are maintained. Too often, presuppositions have come to dominate our thinking about degradation and pressure on resources when there is evidence for alternative views. In one well-known study, for example, Michael Mortimore, Mary Tiffen, and Francis Gichuki described how a combination of soil conservation and new economic activities in the Machakos region of Kenya has resulted in greater well-being with less damage to the land.(3) Similarly, in Nepal, where analysts have decried the destructive nature of the frequent landslides, research has shown that many farmers actually anticipate these landslides, using them to refresh degraded soils and build terraces.(4)

These instances are examples of adaptation. In the context of developing countries, an adaptation is a strategy adopted to reduce the impacts of environmental or social change on local resources.(5) Although there are many examples of successful adaptations, their role in avoiding environmental degradation is still unclear. Critics have suggested that at some point local strategies may be weakened or even reversed by social and economic changes. Furthermore, they argue, some adaptations may only protect certain resources or benefit only some members of a community.(6) One must be wary, therefore, of saying that adaptations are successful just because particular adaptive practices have certain positive effects. Societies often contain divisions based on gender, caste, or other factors that limit adaptive success to certain individuals or households or that render that success short-lived. For this reason, it is important to examine how adaptations come about and why they succeed or fail.

Defining Adaptations

Environmental adaptations include measures such as technological innovations, changes in land-use practices, and economic diversification that reduce the impacts that local people have on their land and other natural resources. (Because this simple definition masks decades of research into the origins of adaptations and their impacts on local livelihoods and environmental management, a more extensive discussion is presented in the box on page 9). The following examples illustrate the nature of the adaptations in three key land-use situations in developing countries.

Agriculture in Highland Areas

Those who cultivate the steep slopes found in highland areas are especially vulnerable to declining soil fertility and accelerating erosion. However, certain adaptations may reduce the impact of such farming on soil resources. The Wola people, who inhabit the southern highlands of Papua New Guinea, offer one interesting example. The Wola are sedentary agriculturists who grow crops on slopes cleared of the native forests by means of slash-and-burn techniques. This type of agriculture is usually thought to damage the environment by accelerating soil exhaustion and thereby leading to further deforestation. (Increasing population may place additional pressure on the land.)⁽⁷⁾ Yet research has shown that the Wola are able to maintain soil fertility by constructing mounds of soil using rotting vegetation as compost. They call these mounds *em hul*, or "bone gardens," because of their bonelike durability. Another technique they employ is to plant a variety of crops (sweet potato, taro, wild spinach, and sugar cane) during the first few years of cultivation and just sweet potato thereafter. The soil mounds provide a rich supply of carbon and nitrogen for the mixed crops, while sweet potato can thrive with far fewer nutrients.⁽⁸⁾

The Mien (Yao) people living in the highlands of northern Thailand offer a similar example. The Mien immigrated from China and Laos, where they practiced shifting cultivation, earlier in this century. Historically, repeated exhaustion of the soil forced them to relocate their villages every 10 to 20 years. Since coming to Thailand, however, they have remained settled for more than 50 years - more than enough time for their soil to lose its fertility.⁽⁹⁾ They have avoided this threat by concentrating cultivation on the flatter slopes rather than the steeper ones where erosion is more likely. Indeed, since the creation of a voluntary protected forest area near one village in the 1970s, the areas of closed forest have almost tripled. Clearly, Mien farmers have perceived the potential threat of erosion and adapted their farming practices to overcome it.⁽¹⁰⁾

Management of Dryland Soils

In the Sahel area of West Africa, farmers face a variety of problems resulting from the vagaries of the climate, particularly the fact that shortages of rainfall have occurred at irregular intervals since the 1970s. Drought threatens both soil and water conservation, and increasing population and political uncertainty provide further challenges to farmers. Nonetheless, the region offers examples of successful adaptation.

The Mossi, who inhabit the central plain of Burkina Faso, are one such example. Burkina Faso faces some serious challenges. Its population is growing at the relatively rapid rate of about 2.6 percent per year, and the yields of rain-fed cereals and pulses (crops such as peas and beans) are unpredictable due to frequent droughts and wide variations in soil quality. To maintain the integrity of their soil under such conditions, the Mossi have adopted such practices as creating compost pits to enhance soil fertility and building *diquettes* (semipermeable lines of stone placed at right angles to the slope) to prevent erosion. International development agencies have aided these adaptive strategies by promoting innovations in both the design and the implementation of conservation techniques.⁽¹¹⁾

A long-standing adaptive process in this region is for farmers to migrate from the drier northern areas to Burkina's cities (or to the neighboring country of Cote d'Ivoire) for wage employment during the dry season, when they do not work on the land. Most Mossi communities have a significant number of people living elsewhere for shorter or longer periods and sending back remittances to their families. Migration has allowed farmers to increase their options for income generation while reducing the pressures on the land and local food supply. (12)

The Kano region of northern Nigeria provides a parallel case of dryland adaptation. Despite population densities in excess of 200 people per square kilometer, farmers have maintained high crop yields through a process of agricultural intensification. As part of this process, they employ distinct cereal genotypes suited to different climatic conditions. Many farmers have also returned to the once-common practice of collecting wild seeds in addition to obtaining seeds from standard commercial sources. During dry years, they supplement their income from crops by raising more goats and sheep, mixing farming with business activities, engaging in paid agricultural labor, and migrating to the cities for short-term wage employment. (13)

These adaptations have reduced the potential impact of drought or politico-economic uncertainties by diversifying the sources of income, promoting land conservation, and ensuring a more secure food supply. By and large, sustainable farming practices have evolved without widespread development assistance or support from the Nigerian government or nongovernmental organizations, though in some cases local organizations have evolved to help farmers make the transition.

Forest Protection and Regrowth

In tropical forest environments, local people face a variety of threats to their livelihoods from logging, the influx of new settlers, land clearance for extensive agriculture, the degradation of forest species used for food, and construction. Commonly, local cultivators are blamed for the destruction of the forests in which they dwell. Research, however, suggests that many communities actually strive to restrict such destruction.

In the forest-savanna transition zone of Guinea in West Africa, scientists and policymakers have blamed the Kissi and Kuranko people for the deforestation that has occurred during the last 200 years. Officials claim, for instance, that some 800 patches of forest land in Kissidougou province represent relics of a larger forest that once covered this entire area. However, research into historical land-cover patterns and local forestry practices suggests that the Kissi and Kuranko actually created these patches on relatively treeless savannas through a painstaking process of altering fire and soil conditions (i.e., targeted burning to reduce the risk of fire and increase soil fertility, gardening to promote tree growth, and the tethering of animals). Indeed, this research indicates that some 71 percent of the 38 villages surveyed were founded in areas of savanna and encouraged forest growth around them. (14)

One of the farmers' key strategies has been to promote the growth of the "silk-cotton" tree and other fast-growing [TABULAR DATA FOR TABLE 1 OMITTED] species that increase forest area, provide wood, reduce the risk of fire, and once helped conceal villages from attackers. As part of this process, grazing cattle have been used to reduce the fire risk by removing flammable grasses. Villagers have also fostered the growth of tree species that provide tree crops and medicines by transplanting wild trees or planting suckers or cuttings. This example reveals how villagers may organize to protect resources not only through the short-term use of fire but also through the long-term process of nurturing forest islands. So-called "natural" landscapes in this region may in fact be largely created by humans.

In Thailand, shifting cultivators have been blamed for increasing the rate of deforestation and degrading forest quality. Research among the Lawa and Karen ethnic groups, however, suggests that the accusations are overstated. Farmers among these groups have adopted the practice of leaving "relict emergents" (specially selected trees) on cultivation sites after burning the remaining vegetation to make way for crops. As a result of leaving some trees, the forest grows back more quickly, the trees are taller, and there is more biodiversity than would otherwise be the case. These forests may even be more beneficial to the local people than those stemming from government reforestation schemes. (15) The Lawa and Karen have lived in northern Thailand for centuries, and they are known for their ability to rotate cultivation sites to protect soil fertility and forest diversity.

Table 1 above summarizes the case studies presented in this section. As a group, they indicate that local people do indeed adopt land practices that reduce the negative impacts on natural resources and, in some cases, they even act to restore or increase those resources.

Explaining Adaptations

The examples given above call into question some general assumptions about the links between poverty and environmental degradation. Instead of poverty leading inexorably to more degradation and vice versa, they suggest that local adaptations may both enhance livelihoods and protect natural resources. In addition, they remind us that there are long-term adaptive processes at work in societies that should be viewed not in mechanical, evolutionary terms but as organized and considered responses to local problems. For these observations to be of value, however, it is important to explain exactly how adaptations work.

Researchers have sought to explain adaptations in a variety of ways. As discussed in the box on page 9, one key distinction is that between adaptive strategies and adaptive processes. Strategies are short-term practices adopted in response to sudden shocks or difficulties in accessing resources. Processes are longer-term transitions that change the relationship of a society to its resource base. Table 2 on this page summarizes how adaptive strategies are themselves responses to long-term processes such as population growth and the diversification of rural incomes.

Each transition has several components. For example, a common adaptive response to land pressures is to adopt conservation measures such as those undertaken in Burkina Faso and Nigeria. Whether such measures will be adopted (and the form that they take) depends on several "arbiters of change," including the knowledge farmers have, the biophysical environment (particularly rainfall and soil conditions), and the availability of labor. For this reason, each transition will be relatively unique, reflecting the interactions between people, their institutions, their political economy, and their environment.

Figure 1 on page 26 presents a basic model of adaptation showing how adaptive strategies and processes respond to and influence the underlying "vulnerability context" (as determined by environmental, social, and economic processes) and how societies draw upon resources of different types (their so-called natural, social, and economic capital) to do so. A local livelihood system is composed of people who pursue adaptive behaviors to create and sustain that system. But these individuals are not isolated adaptors - they are instead enmeshed in a number of transforming processes, such as the workings of social and economic institutions, government bodies, and other organizations. It is the interaction between structures, processes, and adaptations that gives rise to specific livelihood outcomes. [TABULAR DATA FOR TABLE 2 OMITTED] For example, in the case of the Mossi farmers, it was the combination of indigenous adaptive strategies to preserve soil and water with the technical knowledge supplied by international NGOs and development organizations that led to the widespread construction of diguettes in Burkina Faso in the last two decades. Soil and water

conservation has changed the resilience of local food systems and in most cases increased food security as well as reduced vulnerability. The community's capital assets have been altered in the process, with its natural capital being expanded via improved fields and its social capital via working together on conservation projects.

The examples presented in the previous section are admittedly optimistic about human potential and creativity. They show, for example, that the Wola of Papua New Guinea have utilized centuries of experimentation with growing crops to increase their food security under conditions of a growing population.(16) Similarly, in Burkina Faso and Nigeria, traditional knowledge has included an understanding of crop and livestock diversification, along with the shorter-term possibilities offered by migration.(17) And in Guinea and Thailand, knowledge of biophysical resources acquired over many years has been employed in shaping forest growth to local needs.

In these instances, adaptive strategies (such as the creation of soil mounds or forest islands) blend with adaptive processes (such as more permanent cultivation or diversifying income sources). In addition, adaptive processes often involve the spatial expansion of activities away from the locality to reduce local resource pressures, as in the migration of people from Burkina Faso to Cote d'Ivoire to supplement their incomes. In some cases, the migrants have established social networks at their destinations to reduce the economic and social risks of seasonal migration. Figure 2 on page 28 shows a basic model of adaptive processes as they occur over larger and larger temporal and spatial scales, highlighting the fact that this means moving beyond local social, economic, and natural resources into increasingly wider systems. This is particularly appropriate for dryland communities, where diversification is the most common response to crop failure or drought.

The Down Side to Adaptation

Despite the benefits conferred by adaptative strategies and processes, researchers are increasingly pointing to their potentially negative impacts on some individuals. In particular, critics have suggested that the growing spatial and temporal scales of adaptations may mean that only some resources are protected and only some members of the community benefit. Indeed, the word community may be inappropriate in this context because it suggests that there is a unity among a diverse group of individuals who may also be divided along age, gender, caste, ethnic, and class lines.

In the Sahel region, for example, many of those who migrate in search of work fail to find it, to the great detriment of those left behind. (Nearly all of the migrants are men trying to support their families,(18)) Those who do find employment may become part of highly competitive labor or product markets, with only small gains (or even losses) to show for their efforts.(19) Economic diversification has also led to increased environmental degradation. In northern Thailand, for instance, some relatively well off Mien farmers have begun selling souvenirs to tourists and using the income to expand the size of their farms by hiring poorer farmers as agricultural labor. The latter, however, have continued to crop their land frequently, thus increasing the net pressure on farming resources. Little is being done to help those who need extra income the most.(20)

Adaptations themselves may also be fragile and easily abandoned during times of severe social or economic unrest. The flare-up of ethnic violence in Rwanda in 1994-96 offers a good example. In this conflict, more than 1 million people were killed and 2.9 million displaced from their homes. As a result, social and economic networks throughout the country were seriously disrupted and many people lost access to the resources they depend on to earn a living. Large numbers ended up in refugee camps in neighboring countries, heavily dependent on international assistance for mere survival.(21)

The drought that afflicted Sudan from 1983 to 1985, causing approximately 100,000 people to die of starvation, offers another important example. Many of the victims were people with poorly diversified livelihood systems. Dependent on crops and lacking stocks of food or animals, they readily succumbed to famine. Two other factors greatly exacerbated the situation, however. First, the government was poorly prepared for the drought and failed to distribute available food to those who needed it. (22) Second, internal fighting over the last 20 years (the government is waging a war against ethnically distinct people in the southern part of the country) has left 1.3 million people dead and several million homeless, largely precluding any adaptations people would otherwise have made. (23)

Perhaps the most famous debate about the merits of adaptation concerns the Akamba people of the Machakos region of Kenya. According to one classic study, their efforts to increase the food supply while preserving the integrity of their land have turned out very positively. In the authors' memorable phrase, adaptations such as market trading and sustained agricultural intensification on terraced land have enabled "more people" to be supported with "less erosion" and better conservation of biophysical resources. (24)

Other researchers have identified two main problems with this optimistic scenario, however. The first is that the effects on individual livelihoods may be concealed by the use of aggregate data. (25) Using such data implies that all community members have experienced the same level of economic success or failure. In fact, it appears that there are great differences among men, women, and children and between the rich and the poor in this community. Anthropological research has revealed that certain Akamba have experienced alienation from the land, limits on social mobility, and constraints in the food system as a result of the transformations in their society. In other words, the adaptive success of some may have been achieved at others' expense. For this reason, Machakos may not be as startling an example of innovative adaptive strategies promoted by policies and market opportunities as some believe.

The second problem is that environmental adaptations have been accompanied by a redistribution of wealth that may restrict both rich and poor villagers' ability to protect the land. For example, in one village in the Machakos area (where population densities can exceed 500 people per square kilometer), researchers found that only 57 percent of the farmers could afford the capital needed to produce cash crops for the market. Because access to credit is not equally available to all, a significant polarization of wealth has occurred since 1965. In that year, the poorest fifth of households owned 8 percent of the land; in 1995, they owned 3 percent. By contrast, the richest fifth owned 40 percent of the land in 1965 and 55 percent in 1995. Thus, it appears that it was the richer households that convened "more people" into "less erosion" through improvements to the land. Although some members of the community are benefiting from such improvements, many cannot afford them and so are relatively worse off. (26)

Lessons for the Future

What lessons can be drawn from the adaptations that different peoples have made to reduce damage to resources and maintain their livelihoods within fragile environments? Perhaps most importantly, it is clear that there is little evidence for either broad-brush Malthusian assertions about the links between poverty and environmental degradation or for uncritical Boserupian optimism about human abilities to avoid resource depletion. Adaptations indeed have positive impacts on local development opportunities and environmental protection. However, the case studies discussed above indicate that they are also contingent on the vulnerability context, the forms of capital available, and the historical dynamics of livelihood systems. The most sustainable solution for development and environmental management may be to consider adaptive capabilities as integral features of local livelihood systems

and to support them where possible while continuing to tackle the more deep-seated causes of poverty.

Increasingly, development practitioners are adopting the concept of "sustainable livelihoods" as a framework for supporting adaptations (see the box on page 29 for more on this concept). A livelihoods approach focuses on the ability of rural people to discover, formulate, and carry out adaptive strategies and processes. It acknowledges that such people usually do take measures to protect their resources and avoid poverty or marginalization when they have the necessary local institutional support and expertise. As a result, sustainable livelihoods programs seek to formalize and strengthen local institutional capacity for environmental adaptations by working through community associations, farmers' organizations, and agricultural networks.

The sustainable livelihoods perspective also highlights the fact that adaptive strategies rely on knowledge of and engagement with broader economic systems and ideas. Indeed, it is essential that adaptations have broader spatial and temporal scales to help increase the social and economic resilience of local communities as well as their access to natural, social, and economic capital.(27) Unlike adaptations based on increased access to regional or international labor markets, however, sustainable systems are characterized by some degree of local choice and control with respect to participation in markets and migration opportunities. The key lesson is that environmental adaptations need to be both diverse and accessible to all members of a community to ensure that they actually work against environmental degradation and poverty.

The value of taking a sustainable livelihoods approach is evident in the Andes of Ecuador and Bolivia.(28) Like many highland areas in the Chimborazo Province of Ecuador, Gatazo suffers from poverty, outmigration, and long-term soil erosion. But local efforts since the mid-1970s have succeeded in intensifying agriculture (particularly on the lower, water-fed pampa lands) and in investing in new, high-value products such as horticultural crops. Similar results have been recorded in Alto Beni in Bolivia, where small-scale agricultural production and failed efforts to grow cocoa have gradually given way to market-oriented organic cocoa production. Intensification of agriculture has required establishing new trading links with the outside world as well as eliminating local monopolies to allow more local farmers to participate in the broader markets. In both cases, the creation of local trade associations (sometimes in coordination with nongovernmental organizations, development workers, or inspiring individuals who have acted as catalysts to indigenous adaptations) has helped communities identify product niches and exploit them successfully.

In these examples, villagers have been able to gain entry into regional trading systems through a combination of local production and the ability to ensure that most farmers have access to markets. Success has also been based on forging other links to the outside world, notably relationships with a university horticulturist (in Gatazo) and European donor agencies (in Alto Beni). In both cases, adaptations have combined experimentation with crops and agricultural technologies with an appreciation of wider systems of financial opportunities and markets. In each case, there have been sustainable benefits for local residents and an increased chance of their reaching poorer households owing to the strength of farmer institutions and cooperatives.(29)

In conclusion, poverty, environmental degradation, and social and economic change interrelate in complex ways that offer hope as well as despair, opportunity as well as vulnerability. Human adaptations are still common where vulnerability appears to be great, and adaptive behavior and strong institutions can clearly reduce pressures on natural resources. Yet adaptations have to work within sustainable livelihood systems that may not be based on local capital and local natural resources. There are risks involved in the exploitation of opportunities, particularly those that take individuals away from their communities or subject those communities to additional social or political

pressures as a result of diversifying and extensifying their livelihood systems.(30) Still, by creating institutional capacity - and an environment that permits the accumulation of a range of capital assets - societies can produce benefits for people and their environments. Local land users have already proven that they can fight back against degradation. With support for sustainable rural livelihoods, communities can also overcome the social and economic factors that serve to hinder sustainable development.

NOTES

1. R. W. Kates and V. Haarmann, "Where the Poor Live: Are the Assumptions Correct?," *Environment*, May 1992, 4; and J. Kasperson, R. Kasperson, and B. L. Turner II, "Regions at Risk," *Environment*, December 1996, 6.
2. See S. Berry, "Social Institutions and Access to Resources," *Africa* 59, no. 1 (1989): 41; E. Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge, U.K.: Cambridge University Press, 1990); and J. Baland and J. Platteau, *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?* (Oxford, U.K.: Clarendon Press, 1996).
3. M. Mortimore and M. Tiffen, "Population Growth and a Sustainable Environment: The Machakos Story," *Environment*, October 1994, 10; M. Tiffen, M. Mortimore, and F. Gichuki, *More People, Less Erosion?: Environmental Recovery in Kenya* (Chichester, U.K.: John Wiley & Sons, 1994); E. Boserup, *The Conditions of Agricultural Growth* (London: Allen and Unwin, 1965); and B. L. Turner II, G. Hyden, and R. W. Kates, eds., *Population Growth and Agricultural Change in Africa* (Gainesville, Fla.: University of Florida Press, 1993). Such works present an alternative to Malthusian ideas like those in P. Ehrlich and A. Ehrlich, *The Population Explosion* (London: Hutchinson, 1991).
4. H. Kienholz, G. Schneider, M. Bichsel, M. Grunder, and P. Mool, "Mapping of Mountain Hazards and Slope Stability" *Mountain Research and Development* 4, no. 3 (1984): 247; A. Byers, "An Assessment of Landscape Change in the Khumbu Region of Nepal Using Repeat Photography," *Mountain Research and Development* 7, no. 1 (1987): 77; and J. Ives and B. Messerli, *The Himalayan Dilemma: Reconciling Development and Conservation* (London and New York: Routledge, 1989).
5. Boserup, note 3 above; and Turner et al., note 3 above.
6. M. Leach, R. Mearns, and I. Scoones, eds., "Community-based Sustainable Development: Consensus or Conflict?" *IDS Bulletin* 28, no. 4 (1997).
7. A. Rambo, "No Free Lunch: A Reexamination of the Energetic Efficiency of Swidden Agriculture," in A. Rambo and P. Sajise, eds., *An Introduction to Human Ecology Research on Agricultural Systems in South East Asia* (Los Banos, the Philippines: University of the Philippines, 1984), 154.
8. P. Sillitoe, "It's All in the Mound: Fertility Management under Stationary Shifting Cultivation in the Papua New Guinea Highlands," *Mountain Research and Development* 18, no. 2 (1998): 123; and P. Sillitoe, *A Place against Time: Land and Environment in the Papua New Guinea Highlands* (Amsterdam: Harwood Academic Press, 1996).
9. T. Grandstaff, *Shifting Cultivation in Northern Thailand: Possibilities for Development* (Tokyo: United Nations University Press, 1980).

10. T. Forsyth, "Science, Myth, and Knowledge: Testing Himalayan Environmental Degradation in Thailand," *Geoforum* 27, no. 3 (1996): 375.
11. N. Atampugre, *Behind the Lines of Stone: The Social Impact of a Soil and Water Conservation Project in the Sahel* (Oxford, U.K.: Oxfam Publications, 1993).
12. S. Batterbury, "The Political Ecology of Environmental Management in Semi-arid West Africa: Case Studies from the Central Plateau, Burkina Faso" (Ph.D. diss., Clark University, Worcester, Mass., 1997; available through University Microfilms International, Ann Arbor, Mich.); S. Batterbury, "Planners or Performers?: Reflections on Indigenous Dryland Farming in Northern Burkina Faso" *Agriculture and Human Values* 13, no. 3 (1996): 12; and D. D. Cordell, J. W. Gregory, and V. Piche, *Hoe and Wage: A Social History of a Circular Migration System in West Africa* (Boulder, Colo.: Westview Press, 1996).
13. M. Mortimore, "The Intensification of Peri-urban Agriculture: The Kano Close-Settled Zone, 1964-1986," in Turner et al., note 3 above, page 356; W. Adams and M. Mortimore, "Agricultural Intensification and Flexibility in the Nigerian Sahel," *The Geographical Journal* 163, no. 2 (1997): 150; and M. J. Mortimore and W. M. Adams, *Working the Sahel* (London: Routledge, 1999).
14. J. Fairhead and M. Leach, *Misreading the African Landscape: Society and Ecology in a Forest-Savanna Mosaic* (Cambridge, U.K.: Cambridge University Press, 1996).
15. D. Schmidt-Vogt, "Defining Degradation: The Impacts of Swidden on Forests in Northern Thailand," *Mountain Research and Development* 18, no. 2 (1998): 135; and D. Schmidt-Vogt, *Swidden Farming and Fallow Vegetation in Northern Thailand*, *Geocological Research*, vol. 8 (Stuttgart, Germany: Franz Steiner Verlag, 1998).
16. M. Johnson, ed., *Lore: Capturing Traditional Environmental Knowledge* (Ottawa, Canada: Dene Cultural Institute, International Development Research Centre, 1992); and B. DeWalt, "Using Indigenous Knowledge to Improve Agriculture and Natural Resource Management," *Human Organization* 53, no. 2 (1994): 123.
17. A. J. Bebbington, "Capitals and Capabilities: A Framework for Analyzing Peasant Viability, Rural Livelihoods, and Poverty" *World Development* 27, no. 12 (1999).
18. R. David, ed., *Changing Places? Women, Resource Management, and Migration in the Sahel* (London: International Institute for Environment and Development and SOS Sahel UK, 1995).
19. International Institute for Sustainable Development, *Adaptive Strategies for Sustainable Livelihoods in Arid and Semi-arid Lands* Project report available at <http://www.iisd.ca>.
20. T. Forsyth, "Tourism and Agricultural Development in Thailand," *Annals of Tourism Research* 22, no. 4 (1995): 877.
21. Interestingly, the processes of adaptation and innovation went forward even under such dire circumstances. Refugees, for instance, sought agricultural work in their new locations, along with planting some crops, harvesting forest products, and setting up rudimentary markets. For more on the refugee crisis in Rwanda, see P. Uvin, "Tragedy in Rwanda: The Political Ecology of Conflict," *Environment*, April 1996, 6.

22. See P. Blaikie, T. Cannon, I. Davis, and B. Wisner, *At Risk: Natural Hazards, Peoples' Vulnerability, and Disasters* (London: Routledge, 1994). The Sudan experience highlights the fact that risk depends not only on the probability of natural and other disasters but also on the measures that have been taken to prevent or respond to them. For another instance in which lack of preparedness exacerbated a natural disaster, see M. Kerry, G. Kelk, D. Etkin, I. Burton, and S. Kalhok, "Glazed Over: Canada Copes with the Ice Storm of 1998," *Environment*, January/February 1999, 6.

23. N. Middleton and P. O'Keefe, *Disaster and Development: The Politics of Humanitarian Aid* (London: Pluto Press, 1998); and R. Black, *Refugees, Environment, and Development* (Harlow, U.K.: Addison Wesley Longman, 1998).

24. Tiffen et al., note 3 above; and M. Tiffen, "Demographic Growth and Sustainable Land Use" *Advances in GeoEcology* 31 (1998): 1,333.

25. D. Rocheleau, "More on Machakos," *Environment*, September 1995, 3; and D. Rocheleau, P. Steinberg, and P. Benjamin, "Environment, Development, Crisis, and Crusade: Ukambani, Kenya, 1890-1990," *World Development* 23, no. 6 (1995): 1,037.

26. J. Mutton, "Coping with More People: Population Growth, Nonfarm Income, and Economic Differentiation in Machakos District, Kenya" (Ph.D. diss., University of Cambridge, 1997); and J. Mutton, "Population Growth and Poverty in Machakos District, Kenya," *The Geographical Journal* 165, no. 1 (1999): 37.

27. Many researchers believe that "social capital" (the networks, norms, and mutual trust found within a cohesive society) aids development because it increases people's ability to create institutions and to work together. See, for example, R. Putnam, *Making Democracy Work: Civic Traditions in Modern Italy* (Princeton, N.J.: Princeton University Press, 1993). A full treatment of this concept is beyond the scope of this article. There is, however, a growing debate about indigenous social capital formation and the possible confusion between the growth of trust as a social force and the simple creation of apolitical associations. See J. Harriss, "'Missing Link' or Analytically Missing?," *Journal of International Development* 9, no. 1 (1998): 1.

28. A. J. Bebbington, "Social Capital and Rural Intensification: Local Organizations and Islands of Sustainability in the Rural Andes," *The Geographical Journal* 163, no. 2 (1997): 189; and A. J. Bebbington, "Sustaining the Andes: Social Capital and Policies for Rural Regeneration in Bolivia," *Mountain Research and Development* 18, no. 2 (1998): 173.

29. The phenomenon described here has been referred to as creating an "island of sustainability." This approach is conceptually similar to the sustainable livelihoods and environmental adaptations approaches.

30. See M. Leach, R. Mearns, and I. Scoones, "Institutions, Consensus, and Conflict: Implications for Policy and Practice," *IDS Bulletin* 28, no. 4 (1997): 90; and Leach et al., note 6 above.

RELATED ARTICLE: RETHINKING ADAPTATIONS

The term adaptation holds a central place in the study of the relations between people and the natural environment. An early proponent of the term was an anthropologist who showed as early as 1937 how particular cultural patterns emerged from the constraints and possibilities afforded by that

environment.(1) He identified a cultural "core" within societies that allows them to adopt new technologies and survival strategies for meeting essential needs such as food production. In 1971, another scholar put forth the more radical idea that adaptations serve to ensure human survival against various biophysical threats within the ecosystem (in keeping with this thesis, he focused on optimal foraging strategies, i.e., ways to obtain required nutrition for the least effort).(2) At the same time, geographers were identifying a range of "adjustments" made by individuals to deal with natural disasters. These adjustments were based on several factors, including their perception of hazards, the nature of their personal contacts with them, and their personalities.(3)

Today, researchers generally make a distinction between adaptive strategies and adaptive processes. In this context, an adaptive strategy is a practical decision by an individual to permanently change the productive activities in which he or she is engaged (such as selling livestock during drought years or diversifying into new crops based on assessments of climatic and economic conditions). Such strategies are most important for poor communities seeking food security in the face of resource scarcity or rapid socioeconomic change. An adaptive process, on the other hand, entails a strategic, long-term decision such as undertaking long-distance migration or constructing terraces on steep agricultural lands. Adaptive strategies and processes both involve a variety of major and minor changes to local practices and social organization. Either may be called adaptations, and they may occur over a variety of time scales. In the words of another anthropologist, the "particular circumstances of geography, demography, technology, and history" result in a "splendid variety of cultural values, religion, kinship systems, and political structures" that may lead to a great range of livelihood strategies.(4) Adaptations offer sufficient benefits to be adopted on a long-term basis, but as anthropologists and geographers remind us, it is not helpful to see them merely as relatively straightforward changes made in response to environmental stress. Not only have people been severed from their resource base through displacement or hazards, there are adaptations that have negative impacts elsewhere or in relation to other processes (soil conservation up-slope can disadvantage farmers lower down, for example).

Researchers adopting an adaptation framework have illustrated the ability of local groups to assert their autonomy from economic or political change, and ingenious adaptations and innovations form a part of this process.(5) Much can be learned from the careful study of such tactics, particularly in agrarian systems. Nonetheless, the identification and measurement of adaptations - and assessment of their sustainability - is not possible without long-term observation or reference to the multiple constraints (e.g., exploitation, forced migration, and commercial systems that disadvantage the rural poor) that can impede the process of adaptation.(6) While people frequently overcome such constraints, one must bear in mind there are many more components to the maintenance of sustainable local livelihood systems than simple adaptation to environmental stresses.(7)

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RELATED ARTICLE: Sustainable Livelihoods

The concept of a sustainable livelihood has been adopted by some development agencies, notably certain sections of the United Nations Development Programme and the United Kingdom's Department for International Development, as a guiding principle in development policy.(1) In simple terms, a "livelihood" may be defined as the capabilities, resources and other assets, and activities required for making a living. A "sustainable livelihood" is one that

can cope with and recover from stress and shocks, maintain and enhance its capabilities and assets and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term.(2)

By rejecting the assumption that there is an inescapable link between poverty and environmental degradation, the concept of sustainable livelihoods offers new, more positive approaches to local resource management. As now used, the concept extends the economist Amartya Sen's concept of "entitlements" by focusing on individuals' access to resources rather than that of the "community," which may not fully reflect differences in gender, age, class, and caste. Furthermore, the enhancement of sustainable livelihoods requires building local institutional capacity to assist in the selection of adaptations by land users themselves rather than intervening directly to shape the adoption of adaptations developed outside the local community. Indeed, the attention to local political and institutional structures in rural areas - rather than to specific land management techniques - makes the sustainable livelihoods approach transferable between different regions of the globe.

1. I. Scoones, *Sustainable Rural Livelihoods: A Framework for Analysis*, IDS Working Paper 72 (Brighton, U.K.: Institute of Development Studies, 1998); T. Forsyth, M. Leach, and L. Scoones, *Poverty and Environment: Priorities for Research and Policy - An Overview Study*, Paper prepared for the United Nations Development Programme and the European Commission (Brighton, U.K.: Institute of Development Studies, 1998); and D. Carney, ed., *Sustainable Rural Livelihoods: What Contribution*

Can We Make? (London: Department for International Development, 1998). The Institute of Development Studies is a leading research institution in this area, and interested readers may wish to contact its Web site, <http://www.ids.ac.uk>, for more information.

2. R. Chambers and G. Conway, *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century*, IDS Discussion Paper 296 (Brighton, U.K.: Institute of Development Studies, 1992).

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